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RESEARCH ARTICLE

Organizations, Market and Performance

The Relationship between Organizational Leadership for Safety and Learning from Patient Safety Events

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Objective. To examine the relationship between organizational leadership for patient safety and five types of learning from patient safety events (PSEs).
Study Setting. Forty-nine general acute care hospitals in Ontario, Canada.
Study Design. A nonexperimental design using cross-sectional surveys of hospital patient safety officers (PSOs) and patient care managers (PCMs). PSOs provided data on organization-level learning from (a) minor events, (b) moderate events, (c) major near misses, (d) major event analysis, and (e) major event dissemination/communication. PCMs provided data on organizational leadership (formal and informal) for patient safety.
Extraction Methods. Hospitals were the unit of analysis. Seemingly unrelated regression was used to examine the influence of formal and informal leadership for safety on the five types of learning from PSEs. The interaction between leadership and hospital size was also examined.
Principal Findings. Formal organizational leadership for patient safety is an important predictor of learning from minor, moderate, and major near-miss events, and major event dissemination. This relationship is significantly stronger for small hospitals (<100 beds).
Conclusions. We find support for the relationship between patient safety leadership and patient safety behaviors such as learning from safety events. Formal leadership support for safety is of particular importance in small organizations where the economic burden of safety programs is disproportionately large and formal leadership is closer to the front lines.

Key Words. Patient safety, safety culture, leadership, learning from safety events/incidents

Patient safety events (PSEs), including preventable adverse events and near misses, will continue to occur in health care (Gaba 1994); it is essential therefore to gain a better understanding of these events and to learn from them (Kohn, Corrigan, and Donaldson 1999; Vincent et al. 2000; Etchells and Bernstein 2001; Walshe 2003). Knowledge of the factors that influence learning from PSEs can inform efforts to improve patient safety (Chuang, Ginsburg, and Berta 2007). Empirically, leadership has been shown to be an important explanatory variable for organizational improvement activities other than patient safety improvement initiatives, including the utilization of research findings (Huberman 1994), perceptions of performance data (Ginsburg 2003), and clinical involvement in CQI (Weiner, Shortell, and Alexander 1997). This study examines the relationship between leadership for patient safety—both formal and informal—and learning from PSEs in general acute care hospitals.

LITERATURE

Leadership and Patient Safety Improvement

Several recent theory papers by experts in the field of patient safety have suggested that visible leadership supporting patient safety improvement efforts is required in order to improve patient safety and reduce AEs (Barach and Small 2000; Reinertsen 2000; Mohr, Abelson, and Barach 2002; Firth-Cozens 2003; Frankel, Leonard, and Denham 2006; Leape 2007). Some progress in subjecting theoretical models of what is needed to create safer systems to more rigorous empirical examination is being made. For instance, a hands-on formal leadership style was found to be one of the hallmarks of academic medical centers receiving high quality and safety scores (Keroack et al. 2007). Visible and involved formal leadership was also identified as being key to implementing an effective patient safety program in a VHA case study (Bagian 2005). Others have shown that success in making changes aimed at

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reducing adverse drug events was associated with strong formal leadership, among other variables (Leape et al. 2000). By and large, however, very little empirical research focusing on the relationship between formal leadership and safety has been carried out in health care settings (Flin and Yule 2004; Weingart and Page 2004).

Other literature suggests that informal leaders—patient safety “champions”—play a critical role in establishing a culture of safety (Anonymous 2002), and that, in the context of anesthesia, informal champions have been a critical success factor for effecting broad-scale improvement in patient safety (Lanier 2006). However, we were unable to find any empirical papers that examined the relationship between informal leadership for patient safety and improved patient safety processes or outcomes. The current empirical study focuses on the concept of leadership, both formal and informal, for patient safety. The present study contributes by presenting an empirical examination of the relationship between organization-level leadership for patient safety and patient safety behavior in organizations. We focus further by looking specifically at the outcome of learning from PSEs.

Learning from PSEs

Health researchers face many challenges as they try to assess “improved patient safety outcomes” and factors or interventions that might lead to these improved outcomes—PSEs are not easily defined and measured in health care (Sutcliffe 2004; Ginsburg et al. 2005) because they are underreported (Lawton and Parker 2002), are relatively infrequent (Rivard, Rosen, and Carroll 2006) (e.g., sentinel events are quite rare), and are easily confounded. This makes it useful to focus on more upstream-dependent variables in patient safety research such as learning from PSEs.

In addition to the literature noted above, there are important theory papers that talk about the importance of leadership specifically in the context of achieving learning in patient safety (Carroll and Edmondson 2002; Walshe 2003; Edmondson 2004). Moreover, in the broader organizational literature, it has been suggested that leadership need not always be formalized to promote organizational learning (Nonaka and Takeuchi 1995). Again, no empirical papers in the health care literature were found that examined the relationship between leadership for patient safety (either formal or informal) and learning from PSEs. We hypothesize that both formal and informal leadership for patient safety will be positively and significantly related to learning from PSEs. Past research suggested that organizational size plays an important role in shaping patient experience (Young, Meterko, and Desai 2000) and health care providers' behaviors (Frankel et al. 2005). Accordingly, we further investigate the moderating effect of organizational size on the relationships between formal and informal leadership for patient safety and learning from PSEs.

Finally, in this study we define and operationalize learning from PSEs as learning responses to PSEs (Ginsburg et al. 2009b). That is, learning responses taken by organizations following PSEs related to the identification and analysis of events as well as change and dissemination activities designed to help reduce re-occurrence of similar events in the future. This definition of learning is rooted in and consistent with theoretical models of learning from failure (Argote 1999; Sasou and Reason 1999). While PSE learning responses can take place at the level of the individual provider, the team, or patient care unit, as well as the organization, we focus on learning from PSEs at the organization level.

METHODS

Sample and Questionnaire Administration

This study uses data from two cross-sectional surveys conducted in general acute care hospitals in Ontario, Canada. One survey was conducted with the senior person responsible for patient safety in each organization (the patient safety officer [PSO]). Another survey was conducted with patient care managers (PCMs) in the organization. In Winter 2006, a letter was sent to the CEO of all 118 general acute care hospitals in Ontario describing this study and inviting each organization to participate by having the PSO and PCMs complete a mail questionnaire. CEOs agreeing to have their organization participate were asked to provide the researchers with the names and contact information for the PSO and all PCMs, excluding those responsible solely for outpatient clinics. Questionnaires and cover letters were subsequently mailed to the PSO and PCMs in 69/118[1] organizations that agreed to participate. Surveys were followed up by reminder cards 2 weeks later and a second mailing to all nonrespondents 4 weeks after that. Fifty-four out of 68[2] PSOs returned a completed questionnaire for a PSO response rate of 79 percent. Two hundred and eighty-two out of 621 PCMs (46 percent) returned a completed questionnaire.

Study Questionnaires

The PSO and PCM questionnaires incorporated both new and validated items designed to measure a number of factors that have been hypothesized to influence organization-level learning from PSEs (including PS leadership, PSE salience, organizational culture, network contacts, safety management systems) and group-level learning from PS events (including group norms, diversity, and inter-group linkages among others; (see Chuang, Ginsburg, and Berta 2007).[3] Different questionnaires were used with PSOs and PCMs since, by virtue of their differing roles, these groups are best able to answer different questions. Accordingly, PSOs were asked to provide data on the organization's learning responses following PSEs (the dependent variable) while data on formal and informal leadership were collected from PCMs. Copies of the PSO and PCM study questionnaires are available from the authors.

Study Measures

Independent Variables. As noted, data on informal leadership for patient safety and formal organizational leadership for patient safety were collected using the PCM questionnaire. The section of the questionnaire concerning informal leadership for patient safety began with a description of this construct: *Healthcare organizations sometimes have informal "champions" or "opinion leaders" who have additional expertise related to patient safety. These individuals tend to provide natural leadership for patient safety that is beyond their formal authority.* PCMs were then asked whether there was one or more patient safety champions in their organization. If their response was "yes," they were asked to provide the individual's title, and to rate how influential this individual (or these individuals as a group) had been at driving and encouraging patient safety using a five-point Likert-type response scale ranging from "not at all influential" to "exceptionally influential." Based on these data the informal leadership variable was calculated with six response levels ranging from 0 (no champion) to 5 (extremely influential champion[s]).

The measure of formal organizational leadership for patient safety was derived from a broader item-set used previously (Ginsburg et al. 2005, 2009c). The organizational leadership for patient safety measure reflects the extent to which respondents perceive that patient safety is valued by an organization's senior leadership and is a priority in the organization. This organizational leadership dimension is one of the most salient dimensions of patient safety culture that is commonly measured in health care (Flin et al. 2006; Zohar et al. 2007) and other industries (Flin et al. 2000; Zohar 2000). Formal organizational leadership for patient safety is a seven-item scale ($\alpha = 0.86$). Sample items include "Senior management has a clear picture of the risk associated with patient care," "My organization effectively balances the need for patient safety and the need for productivity," "Senior management provides a climate that promotes patient safety," and "Senior management considers patient safety when program changes are discussed." The scale score is computed as the mean of all seven items measured using a five-point agree–disagree Likert-type response scale. This measure of organizational leadership for patient safety has been previously described where it was shown to have strong internal consistency ($\alpha = 0.88$) and strong test–retest reliability ($r = 0.82$) (Ginsburg et al. 2009c).

PCM data on formal and informal leadership for patient safety were aggregated to the organization level so that each organization received an informal leadership for patient safety score calculated as the mean of informal leadership scores provided by each responding PCM in the organization and a formal leadership for patient safety score, also calculated as the mean of all responding PCMs.

Dependent variables—learning from PSEs is defined and operationalized as learning responses taken by organizations following PSEs related to (1) event identification, (2) event analysis, (3) implementation of changes, and (4) dissemination of learning (Ginsburg et al. 2009b). As noted, this definition of learning is rooted in theoretical models of learning from failure from the broader organizational literature (Argote 1999; Sasou and Reason 1999) and is also consistent with definitions of double-loop learning (Argyris and Schon 1978). Development of the measure is described in detail elsewhere (Ginsburg et al. 2009b). Learning from PSEs was measured for four types of PSEs of varying severity previously found to be meaningful to providers and managers (minor events, moderate events, major events, and major near-misses—see Ginsburg et al. 2009a). Minor event learning responses, moderate event learning responses, major event learning responses, and major near-miss learning responses are measured using 12, 11, 13, and 13 items, respectively. Sample items for each event type include "In this organization, a process is followed for identifying those minor events that require in-depth review," "Individuals involved in moderate events contribute to the understanding and analysis of the event," "Major near misses are reported to a reporting system that is internal to the hospital," and "The patient and family are invited to be directly involved in the processes that follow major events (analyzing what occurred and making any necessary changes)." All items use a four-point frequency-based Likert-type response scale (*always/almost always*, *usually*, *sometimes*, *never/almost never*). Based on exploratory factor analysis, minor, moderate, and near-miss learning response measures were previously found to be unidimensional and major event learning was found to have two dimensions (factor 1 = nine items related to major event analysis, factor 2 = four items related to major event dissemination/communication of event analyses and changes) (Ginsburg et al. 2009b). All five of these measures have strong α's (see the diagonal in Table 1).

Organizational demographic information on hospital size ($\geq$ or <100 beds) and teaching status was obtained from the Ontario Classification of Hospitals made under the Public Hospitals Act (Ontario Ministry of Health and Long Term Care 2008).

Analysis

Multivariate regression analysis was used to test the unique effect of (a) hospital size, (b) informal leadership for patient safety, (c) formal organizational leadership for patient safety, and (d) the interaction between hospital size and each leadership variable on learning from PSEs. Teaching status was not included as an explanatory variable because there were only six teaching hospitals in our sample (and its inclusion did not alter our results). Analyses were performed using seemingly unrelated regression (SUR) (Zellner 1962). SUR is a statistical

Table 1: Means, Standard Deviations, α's,† and Pearson's Correlations‡

	Mean	*SD*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Major event learning—factor 1	3.63	0.56	*0.91*						
Major event learning—factor 2	2.86	0.80	0.57**	*0.79*					
Moderate event learning	3.03	0.76	0.54**	0.74**	*0.96*				
Minor event learning	2.53	0.67	0.40**	0.65**	0.82**	*0.93*			
Major near-miss event learning	3.03	0.75	0.56**	0.63**	0.77**	0.65**	*0.94*		
Large hospital (>100 beds)	—	—	−0.11	−0.31*	−0.22	−0.18	−0.26		
Formal organizational leadership for safety	3.90	0.44	0.21	0.39**	0.43**	0.29*	0.32*	−0.20	*0.86*
Informal organizational leadership for safety	2.34	1.28	−0.20	−0.05	0.09	0.08	−0.06	−0.22	0.00

†Coefficient α's are italicized and reported in the diagonal where applicable.

‡$N = 49$. Although 54 patient safety officers returned a completed questionnaire, no patient care managers provided data for five of these organizations, leaving 49 cases with complete data for model testing.

*$p < .05$.

**$p < .01$.

technique that solves a set of regression equations simultaneously and allows for error terms to be correlated among the equations. This produces efficient estimates of coefficients and standard errors (Srivastava and Giles 1987). SUR uses log-likelihood estimation methods that follow the χ^2 distribution and model significance is therefore determined by significant χ^2. SUR was run with five learning from PSE-dependent variables (minor, moderate, and major near-miss learning, as well as major event analysis [factor 1] and major event dissemination/communication [factor 2]). Interaction term variables were mean centered to reduce potential multicollinearity effects and to aid in interpretation (Aiken and West 1991). The hierarchical regression analyses included 49 cases where we had PCM and PSO data for an organization.

Results

Table 1 shows the means, standard deviation, and correlations among all independent, dependent, and control variables. Correlations among the independent variables in Table 1 are low—the correlation with the greatest magnitude was 0.43. We further examined the variance inflation factor (VIF) of each independent variable and the interaction terms. The average VIF was 1.57 with the largest VIF of 1.94, thus indicating that multicollinearity was not a problem.

Table 1 shows that organizations engaged most frequently in learning responses related to major event analysis (mean = 3.63, SD = 0.56). Organizations engaged least often in learning responses following minor events (mean = 2.53, SD = 0.67) and dissemination/communication learning responses following major events (mean = 2.86, SD = 0.80). The mean formal leadership for patient safety score shows that PCMs "agree" positively with most statements regarding organizational leadership for safety (mean = 3.90, SD = 0.44, where 1 is strongly disagree and 5 is strongly agree with all seven items in the scale). The mean informal leadership for patient safety score shows that, on average, PCMs in the organizations we studied believe that informal patient safety champions exist but they are only somewhat influential at driving and encouraging patient safety (mean = 2.34, SD = 1.28, where 0 = no champion and 5 = extremely influential patient safety champion).

Tables 2a–e report the SUR models estimating learning from minor events (Table 2a), learning from moderate events (Table 2b), learning from major near misses (Table 2c), major event analysis (Table 2d), and major event dissemination/communication (Table 2e). For each of our SUR analysis, we simultaneously included the same predictors in all five equations. Our first

Table 2a: Learning from Minor Events

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*	*Model 7*	*Model 8*
Hospital size	− 0.273	− 0.165	− 0.223	− 0.147	− 0.178	− 0.143	− 0.175	− 0.167
	(0.18)	(0.19)	(0.19)	(0.19)	(0.18)	(0.19)	(0.18)	(0.18)
Formal leadership (centered)		0.406		0.411	0.699	0.425	0.707	0.593
		(0.213)*		(0.213)*	(0.238)***	(0.216)**	(0.239)***	(0.226)***
Informal leadership (centered)			0.024	0.031	0.057	0.057	0.076	0.048
			(0.08)	(0.07)	(0.07)	(0.10)	(0.09)	(0.07)
Formal leadership (centered) × hospital size					− 1.077		− 1.07	− 0.681
					(0.465)**		(0.465)**	(0.373)*
Informal leadership (centered) × hospital size						− 0.059	− 0.043	
						(0.15)	(0.14)	
Constant	2.716	2.615	2.641	2.604	2.57	2.593	2.563	2.583
	(0.126)***	(0.130)***	(0.136)***	(0.133)***	(0.127)***	(0.135)***	(0.129)***	(0.127)***
Observations	53	49	49	49	49	49	49	49
R^2	0.0417	0.0981	0.0332	0.1014	0.19	0.1043	0.1915	0.178
χ^2	2.3	5.33*	1.69	5.53	11.49**	5.7	11.6**	9.47**

Notes. Two-tailed tests:
*$p<.10$;
**$p<.05$;
***$p<.01$.
Values are presented as β (SE).

Table 2b: Learning from Moderate Events

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*	*Model 7*	*Model 8*
Hospital size	– 0.373	– 0.207	– 0.313	– 0.182	– 0.216	– 0.169	– 0.204	– 0.201
	(0.198)*	(0.20)	(0.22)	(0.20)	(0.19)	(0.20)	(0.19)	(0.19)
Formal leadership (centered)		0.706		0.712	1.028	0.756	1.06	0.885
		(0.228)***		(0.227)***	(0.252)***	(0.227)***	(0.251)***	(0.233)***
Informal leadership (centered)			0.029	0.041	0.07	0.125	0.145	0.057
			(0.09)	(0.08)	(0.08)	(0.10)	(0.10)	(0.08)
Formal leadership (centered) × hospital size					– 1.183		– 1.156	– 0.648
					(0.494)**		(0.488)**	(0.334)*
Informal leadership (centered) × hospital size						– 0.188	– 0.17	
						(0.16)	(0.15)	
Constant	3.252	3.136	3.186	3.122	3.085	3.089	3.056	3.102
	(0.139)***	(0.139)***	(0.153)***	(0.142)***	(0.135)***	(0.142)***	(0.135)***	(0.134)***
Observations	53	49	49	49	49	49	49	
R^2	0.0626	0.2036	0.0495	0.2081	0.2305	0.291	0.3094	0.274
χ^2	3.54*	12.52**	2.55	12.87**	14.68**	20.11***	21.95***	18.15***

Notes. Two-tailed tests:
*$p<.10$;
**$p<.05$;
***$p<.01$.
Values are presented as β (SE).

Table 2c: Learning from Near-Miss Events

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Hospital size	− 0.395	− 0.302	− 0.425	− 0.339	− 0.36	− 0.323	− 0.343	− 0.339
	(0.191)**	(0.2)	(0.208)**	(0.204)*	(0.201)*	(0.2)	(0.197)*	(0.204)*
Formal leadership (centered)		0.476		0.467	0.657	0.521	0.699	0.467
		(0.231)**		(0.230)**	(0.265)**	(0.228)**	(0.261)***	(0.230)**
Informal leadership (centered)			− 0.072	− 0.064	− 0.046	0.041	0.053	− 0.064
			(0.08)	(0.08)	(0.08)	(0.11)	(0.10)	(0.08)
Formal leadership (centered) × hospital size					− 0.713		− 0.676	
					(0.52)		(0.51)	
Informal leadership (centered) × hospital size						− 0.234	− 0.224	
						(0.16)	(0.16)	
Constant	3.23	3.182	3.247	3.205	3.183	3.164	3.145	3.205
	(0.134)***	(0.141)***	(0.148)***	(0.143)***	(0.141)***	(0.143)***	(0.141)***	(0.143)***
Observations	53	49	49	49	49	49	49	
R^2	0.0747	0.1417	0.0817	0.1529	0.1894	0.1843	0.2176	0.1529
χ^2	4.28**	8.09**	4.36**	8.84**	11.45**	11.07**	13.62**	8.84**

Notes. Two-tailed tests:
*$p<.10$;
**$p<.05$;
***$p<.01$.
Values are presented as β (SE).

Table 2d: Learning from Major Events (Factor 1—Analysis)

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*	*Model 7*	*Model 8*
Hospital size	−0.136	−0.075	−0.176	−0.134	−0.149	−0.115	−0.13	−0.123
	(0.15)	(0.16)	(0.16)	(0.16)	(0.16)	(0.15)	(0.15)	(0.15)
Formal leadership (centered)		0.244		0.229	0.367	0.288	0.414	0.263
		(0.18)		(0.18)	(0.204)*	(0.171)*	(0.196)**	(0.17)
Informal leadership (centered)			−0.103	−0.099	−0.086	0.015	0.023	−0.033
			(0.062)*	(0.06)	(0.06)	(0.08)	(0.08)	(0.07)
Formal leadership (centered) × hospital size					−0.517		−0.476	
					(0.40)		(0.38)	
Informal leadership (centered) × hospital size						−0.255	−0.248	−0.149
						(0.118)**	(0.117)**	(0.10)
Constant	3.694	3.669	3.725	3.704	3.688	3.66	3.646	3.678
	(0.102)***	(0.111)***	(0.111)***	(0.110)***	(0.109)***	(0.107)***	(0.106)***	(0.106)***
Observations	53	49	49	49	49	49	49	49
R^2	0.0161	0.0467	0.0643	0.0953	0.1735	0.1252	0.1989	0.1599
χ^2	0.87	2.4	3.37	5.16	10.29**	7.01	12.16**	7.97*

Notes. Two-tailed tests:
*$p<.10$;
**$p<.05$;
***$p<.01$.
Values are presented as β (SE).

Table 2e: Learning from Major Events (Factor 2—Dissemination/Communication)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Hospital size	– 0.552	– 0.392	– 0.545	– 0.432	– 0.477	– 0.419	– 0.465	– 0.464
	(0.201)***	(0.206)*	(0.220)**	(0.211)**	(0.193)**	(0.208)**	(0.191)**	(0.193)**
Formal leadership (centered)		0.625		0.615	1.028	0.658	1.058	0.91
		(0.239)***		(0.237)***	(0.255)***	(0.238)***	(0.253)***	(0.243)***
Informal leadership (centered)			– 0.077	– 0.066	– 0.029	0.015	0.042	– 0.039
			(0.09)	(0.08)	(0.08)	(0.11)	(0.10)	(0.08)
Formal leadership (centered) × hospital size					– 1.546		– 1.52	– 1.106
					(0.499)***		(0.494)***	(0.406)***
Informal leadership (centered) × hospital size						– 0.183	– 0.16	
						(0.17)	(0.15)	
Constant	3.151	3.062	3.141	3.085	3.037	3.054	3.011	3.051
	(0.141)***	(0.146)***	(0.156)***	(0.148)***	(0.136)***	(0.149)***	(0.137)***	(0.136)***
Observations	53	49	49	49	49	49	49	49
R^2	0.1243	0.2097	0.1134	0.2202	0.2393	0.3481	0.3627	0.3377
χ^2	7.52**	13**	6.26**	13.84**	15.42**	26.11***	27.88***	23.96***

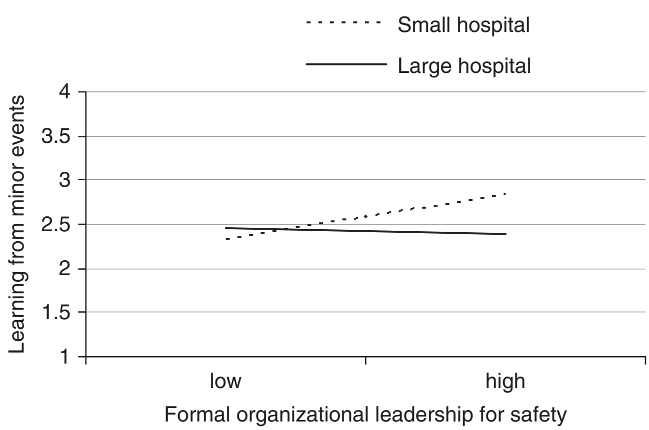
Notes. Two-tailed tests:
*$p<.10$;
**$p<.05$;
***$p<.01$.
Values are presented as β (SE).

SUR analysis included a large hospital dummy variable for hospital size as the only predictor (Model 1 in Tables 2a–e); we then gradually included formal leadership perceived by PCMs, informal leadership perceived by PCMs, and their interactions with hospital size as predictors to derive the full models (Model 7 in Tables 2a–e). In Model 8, insignificant interaction terms were dropped. The χ^2 for Model 8 were significant at the $p<.05$ level for all types of learning we examined except major event analysis. Tables 2a and b show that formal leadership was positively related to learning from minor events and learning from moderate events ($p<.01$), and the interaction between formal leadership and hospital size was negatively related to learning from these two types of events ($p<.10$), while informal leadership had no effect.

In Table 2c, our results show that hospital size was negatively related to learning from major near misses ($\beta = -0.339$, $p<.10$), and formal leadership was positively related to learning from major near misses ($\beta = 0.467$, $p<.05$). However, neither informal leadership nor the two interaction terms had effects. Turning to the two types of learning from major events, our results show neither formal leadership nor informal leadership had impact on major event analysis (Table 2d). In contrast, the coefficient estimate for the interaction between formal leadership and hospital size was negatively associated with major event dissemination/communication ($\beta = -1.106$, $p<.001$).

In addition to their statistical significance, the magnitude of these interaction effects is meaningful. Figures 1, SA1, and SA2 show learning scores for small and large hospitals under conditions of high and low formal leadership

Figure 1: Interaction between Formal Leadership and Hospital Size (DV, Learning from Minor Events)



(1 SD above and 1 SD below the mean) while holding other variables at their means. Figure 1 shows the effect of the interaction between formal leadership and hospital size on learning from minor events and shows that, in small hospitals, an increase of 2 SDs in formal leadership increased learning from minor events by approximately 27 percent. Similar patterns are seen with respect to the effect of interactions between formal leadership and hospital size on learning from moderate events and major event dissemination/communication (Figures SA1 and SA2, respectively). However, in these two cases small hospitals with high formal leadership scores (1 SD above the mean) achieve learning scores that are 34 percent higher than small hospitals with low formal leadership scores (1 SD below the mean) (e.g., small hospitals with high formal leadership scores achieve major event dissemination/communications scores of 3.5 while small hospitals with low formal leadership scores receive major event dissemination/communications scores of 2.6). Figures SA1 and SA2 can be found in the journal's supporting information.

Table 3 summarizes our results based on the reduced models (Model 8). Our overall results indicate that formal leadership exerts a positive influence on four of the five types of learning we examined. Moreover, the positive effects are notably stronger for small hospitals for learning from minor events, learning from moderate events, and for major event dissemination/communication.

DISCUSSION

Our results are interesting for several reasons. First, hospital size appears to play a significant role in influencing learning from major near misses and learning related to major event dissemination/communication activities. The negative regression coefficients show that it is the smaller hospitals in our

Table 3: Summary of Results

	Learning from Minor Events	*Learning from Moderate Events*	*Learning from Near Misses*	*Major Event Analysis*	*Major Event Dissemination/ Communication*
Hospital size (dummy variable)			–		–
Formal leadership	+	+	+		+
Informal leadership					
Formal leadership × hospital size	–	–			–
Informal leadership × hospital size					

sample (those with fewer than 100 beds) that are engaging in greater learning from major near misses and in greater major event dissemination/communication activities.

In terms of the leadership variables we studied, PCM perceptions of formal organizational leadership for patient safety play a significant role in influencing four of the five types of PSE learning we studied. These results lend empirical support to important theoretical papers that have argued that leadership for safety, and a culture where safety is seen as a priority for the organization, is critical for improving safety processes and outcomes (Barach and Small 2000; Reinertsen 2000; Frankel, Leonard, and Denham 2006; Leape 2007).

In addition to these main effects, we found significant interactions between hospital size and PCM perceptions of formal organizational leadership for patient safety for learning from minor events, learning from moderate events, and for major event dissemination/communication activities. These interactions show that formal leadership for patient safety (perceived by PCMs) is particularly effective for promoting learning in smaller hospitals such as those we studied with fewer than 100 beds. Small hospitals with low formal leadership scores (1 SD below the mean) versus those with high formal leadership scores (1 SD above the mean) had learning scores that were nearly one full point apart (and 2 SDs) on the four-point learning scale for moderate events and for major event dissemination/communication. In small organizations, formal leadership support for patient safety may compensate for the fact that small hospitals are less likely to use QI and related safety tools (Nau et al. 2004). This is consistent with work suggesting that the economic burden of safety programs is disproportionately large for small organizations (Fukuda et al. 2009)—work which also showed that perceived lack of administrative leadership was associated with engagement in fewer patient safety and infection control activities. Our findings are also consistent with other research highlighting the structural benefits that smaller organizations enjoy such as leadership that is more visible and proximal to the front lines. For instance, one study showed that, following leadership walkrounds, actions could occur more rapidly in small hospitals than in large hospitals where formal processes were required to address issues (Frankel et al. 2005). And just as the perception that patients may find large hospitals impersonal or intimidating may explain why patient experience data tends to be more positive in small hospitals (Young, Meterko, and Desai 2000), strong leadership for patient safety may be more effective for learning from PSEs in small hospitals because CEOs and senior leaders in those organizations can be more in touch with key stakeholders, including staff and managers at the frontlines (Wells et al. 2004). In other words, small hospitals, by virtue of their size, may be more structurally conducive to having senior leaders visible to front-line staff as they try to improve safety—this need for visibility has been suggested by Pronovost et al. (2003). In contrast, the influence of strong formal leadership for patient safety may be felt less across large organizations.

Put differently, and in keeping with literature on culture as a control mechanism, formal leadership may be more important for bringing about learning in small hospitals because it can more easily be used as a kind of cultural tool to control/promote desirable behaviors in these resource constrained organizations (Ray 1986; Weick 1987). This view reminds us that closely related to the role of leadership in improving safety is the role of patient safety culture. Although the construct of patient safety culture has been defined in numerous ways inside and outside of health care (Ginsburg et al. 2009c), one of the most salient and widely used definitions focuses on the extent to which leadership prioritizes safety relative to other priorities such as efficiency, cost effectiveness, and other organizational imperatives (Zohar 2000). Others have also noted that leadership is undoubtedly "a key theme in improving patient safety and an inherent part of a safety culture" (Mohr 2005; p. 42). While we noted earlier that very little empirical research focusing on the relationship between formal leadership and safety outcomes has been carried out in health care settings (Flin and Yule 2004; Weingart and Page 2004), empirical evidence regarding the relationship between safety culture and safety outcomes is growing in the broader organizational literature (Hofmann and Stetzer 1996; Neal, Griffin, and Hart 2000; Zohar 2000) and emerging in the context of health care (Gershon et al. 2000; Hofmann and Mark 2006; Vogus and Sutcliffe 2007; Zohar et al. 2007). However, evidence from the broader organizational literature suggests that relationships between safety climate[4] and safety behavior/safety outcomes are not perfectly clear (Cooper and Phillips 2004). Indeed, part of this lack of clarity stems from the kind of mediating relationships identified by Barling, Loughlin, and Kelloway (2002), who found that not only is safety climate a significant predictor of safety performance, but it is itself a function of safety-specific transformational leadership. Health services researchers should not lose sight of the fact that the constructs of formal organizational leadership for patient safety and patient safety culture are intimately related and the concept of formal leadership for patient safety can be reasonably framed as both a leadership concept as well as a key dimension of patient safety culture. In either case, in this study we find empirical support for the relationship between organization-level leadership for patient safety and the outcome of PSE learning responses in organizations.

Interestingly, our expectation that informal leadership for patient safety—operationalized as PCMs' perceptions that their hospital had influential patient safety champions—would have a positive impact on learning from different types of PSEs was not supported. The significant interaction between hospital size and informal leadership shown in the nonreduced Models 6 and 7 in Table 2d suggests that in small hospitals the presence of an influential champion may be related to greater major event analysis activities. It may be that the presence of influential champions is important for these types of initial organizational safety activities but not for more difficult organizational initiatives such as responding to noncatastrophic events. This would be consistent with the limited empirical literature on the influence of clinical champions which provides some support that they are effective for straightforward clinical initiatives such as utilizing preventive UTI practices (Saint et al. 2008), using β blockers at discharge post AMI (Ellerbeck, Bhimaraj, and Hall 2006), and promoting evidence-based practice more generally (Davis et al. 1995; Doumit et al. 2007).

We, however, suggest that the role and potential influence of informal patient safety champions should be the subject of further research for two reasons. First, there is some support for the effectiveness of informal champions in more complex contexts such as quality improvement (Pronovost 2003). Second, the measure of informal leadership used in our study is new and is less well validated than the other measures we used. Unreliability can have deleterious effects in regression analysis and may explain our inability to find significant main or interaction effects for informal leadership.

Finally, our results show that none of the explanatory variables we examined or their interactions were significant predictors of the type of learning reflected in major event analysis. Since major event analysis activities are likely the first and most common PSE learning responses in organizations (mean scores reported in Table 1 show that hospitals engaged most often in these learning responses and this variable has smaller variance than the other four DVs [data not shown]), it may be that these learning responses are influenced by different variables than those that influence more advanced learning responses which follow minor, moderate, and near-miss events, and major event dissemination/communication activities.

In addition to the potential limitation associated with our informal leadership measure noted above, the following limitations should also be noted. First, our survey data come from a relatively small sample. Although we had fairly high participation and response rates using a population of hospitals that represents Canada's largest province, for analysis purposes we had only 49 cases where we had data from an organization's PSO and at least one PCM.

This limitation reflects a significant challenge for conducting organization-level research. Indeed, had our sample been larger we would have been able to examine other effects on the relationships between leadership and learning responses (e.g., teaching hospital status). Second, we rely on PCM perceptions of leadership and PSO reports of PSE learning responses in these analyses. Given evidence showing that managers tend to overestimate front-line staff's perceptions of senior leadership for safety (Huang et al. 2007), further research is required to examine whether the relationships we found would be supported if other stakeholder perceptions, such as those of front-line staff, are used to measure leadership and learning from PSEs. Finally, while our PSO response rate was strong, our PCM response rate was 46 percent and little is known about potential nonresponse bias in these kinds of surveys. That said, the structure of our data also offers an important strength. Data for our explanatory variables come from PCMs and secondary data, while dependent variable data come from PSOs. The study data are therefore less subject to the threat of common methods bias that characterizes most survey-based research and tends to spuriously inflate relationships (Williams, Cote, and Buckley 1989; Doty and Glick 1998).

Third, our study examined the effects of PCM perceptions of formal and informal leadership and organizational size on learning responses to PSEs. While PSE learning response is an important dependent variable in its own right (Chuang, Ginsburg, and Berta 2007), future research, however difficult, is required to empirically examine the relationship between PSE learning responses and improvements in other important patient safety outcomes (e.g., AHRQ's patient safety indicators). Finally, the present study contributes to the patient safety culture literature by demonstrating that the key dimension of an organization's patient safety culture, organizational leadership for safety (Flin et al. 2000; Zohar 2000), is an important predictor of learning from several kinds of PSEs. The field would benefit from future research focusing on the influence of leadership at other levels in the organization (Flin and Yule 2004), and front-line leadership for patient safety in particular, as leadership at this level is also critical for achieving learning (Carroll and Edmondson 2002).

Results reported here should be generalizable beyond the Canadian context. In terms of hospital size distribution, our respondent group is similar to the population of general hospitals in Ontario and also to U.S. community hospitals (55 percent of Ontario general hospitals have <100 beds, our sample is comprised of 49 percent small hospitals [<100 beds], and 2005 AHA data indicate that 49 percent of U.S. community hospitals also have <100 beds). Using membership in the Council of Teaching Hospitals (COTH), 14.3 percent of organizations in our study sample are teaching hospitals,[5] a proportion not significantly different from all Ontario teaching hospitals (12 percent) or U.S. teaching hospitals (21.9 percent). It is, however, unclear whether COTH membership criteria are the same in Canada and the United States. Finally, while acute care services in Canada are publicly funded (e.g., single payer) and delivered almost exclusively in not-for-profit hospitals, the Canadian policy environment related to patient safety is similar to other international jurisdictions.[6]

CONCLUSION

It has been suggested that individuals' actions and attitudes toward safety can change, but that this change is unlikely to be sustained without a strong organizational commitment to safety (Firth-Cozens 2003). This organizational commitment to safety is precisely the kind of formal organizational leadership for patient safety we studied. Our results lend empirical support to the importance of this type of leadership for safety for achieving learning from different kinds of PSEs. The role and impact of informal leadership for patient safety on various patient safety processes and outcomes remains an area that requires further research.

By showing that formal leadership for safety is of particular importance in small hospitals, our results also have important practice implications for these organizations that, on one hand may be disadvantaged in terms of human and financial safety resources, and on the other hand are advantaged by close leadership proximity to those at the sharp end. Leaders of larger organizations may need to find ways to more effectively communicate and demonstrate their safety commitment and support to managers at the frontlines to better engage this group in PS learning activities. In addition, the literature suggests that having well-defined PS structures is important in large organizations (Frankel, Gandhi, and Bates 2003), provided there is local empowerment to address and respond to PS events (Frankel et al. 2005). Finally, in terms of policy implications, national accreditation agencies such as JCAHO and Accreditation Canada currently require hospitals to assess their patient safety cultures. Similarly, they may wish to consider developing standards that require organizations to measure the extent to which they are learning from/responding to PSEs. Indeed, recent research (Devers, Pha, and Liu 2004) has shown that rather than professionalism or market forces, hospital patient safety initiatives are primarily driven by regulation such as JCAHO requirements related to improving processes for responding to sentinel events, improving PS culture (as just noted), and improving medication safety. Accordingly, accreditation bodies can play an influential role in compelling hospital leaders to promote patient safety learning practices within organizations (DiMaggio and Powell 1983).

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Disclaimers: None.

NOTES

1. Sixty-nine CEOs agreed to have their organization participate in the study. Many of the CEOs that declined to have their organization participate in the study cited lack of sufficient resources for study participation and survey fatigue as the most common reasons for declining based on a one-page fax survey.
2. One of the 69 hospitals that agreed to participate in the survey was excluded in error at the time of data collection.
3. Copies of the study questionnaires are available from the authors.
4. It is generally accepted that culture and climate are closely related concepts and that safety climate consists of the surface manifestations of the safety culture and can be measured using quantitative measures. See Schein (1990) and Guldenmund (2007) for a detailed description of the layers of culture. We use the term *patient safety culture* except where quoting or citing the work of others who use the term *climate*.
5. We previously noted there were six teaching hospitals in our respondent group. This number is based on The Ontario Public Hospitals Act Classification of Hospitals, which applies a designation of teaching hospital to a more restricted group of hospitals that are approved by the Royal College of Physicians and Surgeons to provide postgraduate education leading to specialist certification. We use COTH membership to define teaching status at this juncture in an effort to use a more comparable definition to AHA.
6. First, Canada has a national sentinel event reporting system and many organizations are trying to implement other local reporting systems. Second, Canada does not use

any notable financial or other incentives that reward safety practices. Third, Canada is increasingly introducing formal disclosure policies and creating senior positions devoted to patient safety such as the PSO position. Finally, while the malpractice environment is different from the United States, issues relevant to learning from PS failures, such as physician's error disclosure attitudes and experiences, have been found to be the same in Canada and the United States (Gallagher et al. 2006).

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Supporting Information

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Figure SA1. Interaction between Formal Leadership and Hospital Size (DV = Learning from Moderate Events).

Figure SA2. Interaction between Formal Leadership and Hospital Size (DV = Major Event Dissemination/Communication).